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A PLAN FOR A NATIONAL COASTAL WATER QUALITY MONITORING NETWORK

Interstate Electronics Corporation

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This report provides a concise summerization of the work done under contract 68-01-0160 for the design of a national coastal zone water quality monitoring network. In addition to presenting an outline of the system design, the document provides conclusions obtained during an extensive research and field case study program. A bibliography listing the thirteen reports prepared under the contract is included.

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PROGRAM HIGHLIGHTS

WATER QUALITY MONITORING IS VITAL TO ENVIRONMENTAL PROTECTION

A national plan for coastal water quality monitoring is a vital step for this nation in the process of protecting our environment from irreversible degradation. Fragmented efforts at monitoring and control are ineffective and costly due to a lack of cooperation, uniformity and forward planning. To safeguard the quality of our coastal environment, a national monitoring system has been designed that will encourage conscious action and intelligent decisions for effective pollution abatement.

AN ASSESSMENT WAS MADE OF WHAT IS IN EXISTANCE NOW AND WHAT ELEMENTS OF EXISTING PLANS ARE USEABLE

The logical development of a national plan for monitoring requires that an overview of the problem first be obtained. The various levels of monitoring that have already been initiated at local, state and regional areas have been reviewed, evaluated, and incorporated into a plan which will allow immediate use of existing capabilities on a national basis.

DETERMINE UNIQUE OR COMMON FACTORS OF DIFFERENT GEOGRAPHICAL AREAS

Both the common and the unique monitoring requirements for different geographic areas have been considered in establishing a plan which can be readily implemented, provides optimum control and is cost effective. An evaluation of existing monitoring plans that were designed for specific and environmentally different areas was used to determine the common and unique factors that had to be considered in designing and implementing a national monitoring plan.

THE NATIONAL PLAN IS A MANAGEMENT TOOL FOR COORDINATION OF EFFORTS

Such a national plan should be designed as a management tool for all levels of government. As a minimum, it should provide:

- Documentation of the presence of pollution and changes in pollution levels.
- Capability for trend prediction.
- Calculations showing the real extent of pollution on a national basis.
- Necessary data management tasks for all governmental levels.

HIGHLIGHTS

A PLAN FOR MANAGEMENT, ORGANIZATION, COSTS AND INTERFACE REQUIREMENTS

The national plan is structured to obtain information in a manner such that timely and effective abatement action can be formulated. It has been formulated to utilize all of the viable elements of existing capabilities for monitoring, planning, organization, and management. Where gaps exist, the plan suggests how these should be augmented, changed, or revised. The plan recognizes the differences in organization and needs for monitoring at local, state, and regional levels. Flexibility is provided to encourage interface at all these levels. The plan is structured such that it can be implemented immediately and addresses the requirements for modification, upgrading, and reorientation of present methods.

EPA-NET

The Plan for a National Coastal Water Quality Monitoring Network, called EPA-NET is developed around an Information Center Concept. The first step involves the implementation of information centers and Initial Networks in specific case study areas. When tied together through headquarters, they form the Initial National Network. The next step is to complete and initiate the Program

Development Plan which allows for growth and evolution to the Future Integrated Network.

It is important to point out that portions of these concepts and the philosophy of this plan conceived as early as August 1970 and discussed at least in part with over 1500 people, have already been implemented in several areas (independently or as a result of this study) which is an indication of the timeliness and significance of this program.

THE PROBLEM

In order to safeguard the quality of the nation's coastal waters and to protect our marine environment from further degradation, it is essential to devise a national plan for coastal water quality monitoring that will establish a coordinated effort to acquire, store, retrieve, exchange and use data and information at all levels, local to national. A significant part of the planning is dependent upon consideration of the effects of population density, ocean dumping, industrial waste and thermal discharge on the environment.

For the purpose of this study and report, the coastal zone was considered to comprise the land, waters and submerged regions along the coastline, including the Great Lakes and to extend seaward to the outer limits of the United States contiguous zone, inland to the border of each coastal county, and to the international boundaries with Canada and Mexico. The inland border of a coastal county was used because the entire county was found to be the "least common denominator" among most of the data bases of interest and defined statistical summaries available for analysis of coastal zone water quality monitoring.

The high density of population, and industry in the coastal counties produce the major portion of the pollution that occurs in the defined coastal zone. Therefore, information and

statistics are most conveniently compiled as a function of each of those for each coastal county.

An adequate water quality monitoring and waste management program can only be effective if adequate knowledge exists for the coastal zone and for the water quality that is to be managed. In order to design a coastal water quality monitoring network, one must determine the level of monitoring presently existing in the coastal zone. The essential information has not previously been collected in sufficient detail, and has not adequately covered all geographic areas to be significant in management planning and in the utilization of existing capabilities. The portions of the coastal zone which have been intensely studied in the past are those with specific problems and those located near academic or research facilities.

Many different agencies maintain routine sampling for monitoring purposes in the coastal zone. These programs appear to be duplicative; however, upon closer examination, many support distinctive operational and research needs. Not to be overlooked is a necessity of providing adequate information to the general public. Public interest in environmental monitoring is necessary in order to obtain the long-term support that will be needed to solve pollution problems. This is particularly true in those areas where solutions to the pollution problems will have an

impact on the local economy. It is important that the public understand the federal government's need and response for sound information so that timely environmental decisions can be made.

The many beneficial uses of coastal waters as well as their misuse as waste and pollution sinks make them one of our nation's most important and misused natural resources. Because the processes within these waters know no legal boundaries they are common property of everyone and as such became the responsibility of no one. The economic aspects are external to the user and thus are a responsibility of the total society.

Since the coastal zone crosses so many political boundaries, it is evident that a national plan for monitoring must be established. A national plan should utilize the framework of local, state and government facilities, and address the problems, technical, legal, organizational and management. It is necessary to incorporate existing capabilities into the plan for monitoring which can then be implemented by a duly authorized body. The requirements for a national water quality monitoring network have been derived from the overall need as expressed by all those concerned.

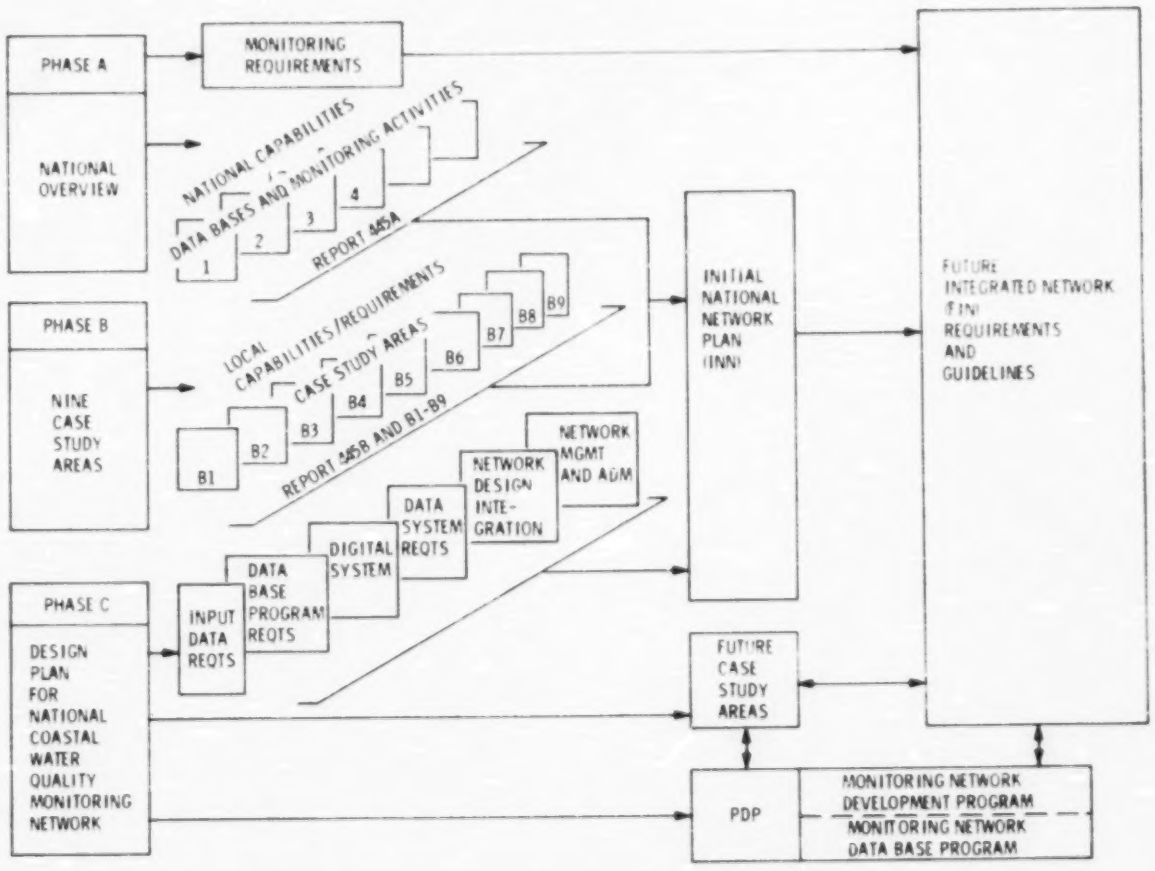

FIGURE 1 PROGRAM DESIGN APPROACH

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APPROACH

THE APPROACH

A three phase approach to conduct the program was used. The first two phases (A and B) provided the background information and user requirements necessary for decisions concerning the actual network design undertaken in Phase C.

The goal of the final report was a plan for the design of a coastal water quality monitoring network using existing capabilities.

The approach leading to a final report as shown on Figure 1 has been to:

- Survey the nation's coastal zone and analyze existing monitoring plans, organization responsibility, data acquisition, and information uses.
- Survey and analyze in-depth nine environmentally and geopolitically different case study areas.
- Develop guidelines for monitoring plans utilizing the common and unique factors for each area.
- Develop the initial local network plans.
- Utilize all information obtained to develop a plan for an Initial National Coastal Water Quality Monitoring Network.
- Prepare a program development plan for a Future Integrated Network.

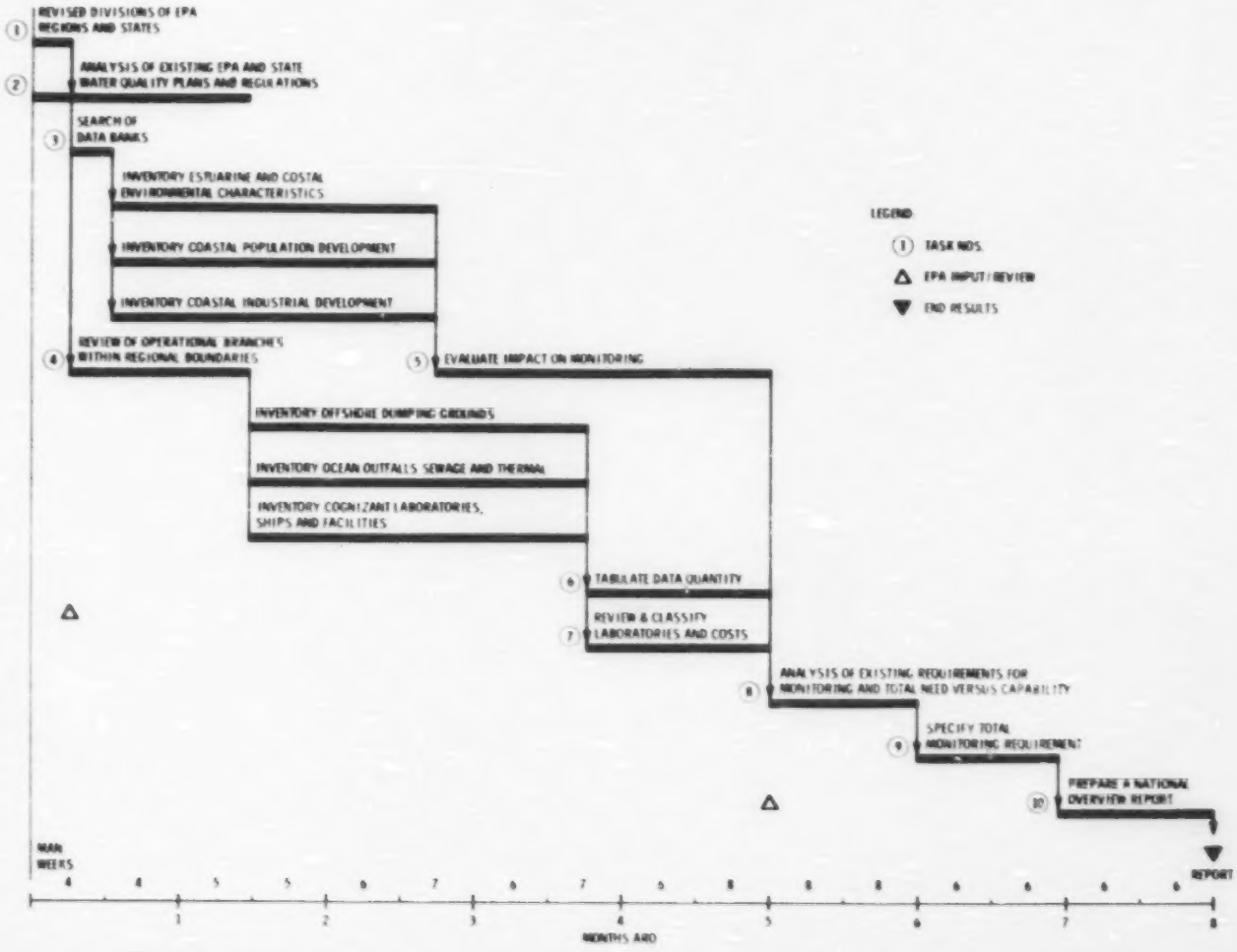
1 REVISED DIVISIONS OF EPA REGIONS AND STATES
2 ANALYSIS OF EXISTING EPA AND STATE WATER QUALITY PLANS AND REGULATIONS
3 SEARCH OF DATA BANKS
INVENTORY ESTUARINE AND COSTAL ENVIRONMENTAL CHARACTERISTICS
INVENTORY COASTAL POPULATION DEVELOPMENT
INVENTORY COASTAL INDUSTRIAL DEVELOPMENT
4 REVIEW OF OPERATIONAL BRANCHES WITHIN REGIONAL BOUNDARIES
5 EVALUATE IMPACT ON MONITORING
INVENTORY OFFSHORE DUMPING GROUNDS
INVENTORY OCEAN OUTFALLS SEWAGE AND THERMAL
INVENTORY COGNIZANT LABORATORIES, SHIPS AND FACILITIES
6 TABULATE DATA QUANTITY
7 REVIEW & CLASSIFY LABORATORIES AND COSTS
8 ANALYSIS OF EXISTING REQUIREMENTS FOR MONITORING AND TOTAL NEED VERSUS CAPABILITY
9 SPECIFY TOTAL MONITORING REQUIREMENT
10 PREPARE A NATIONAL OVERVIEW REPORT
REPORT
LEGEND
TASK NOS.
EPA INPUT/REVIEW
END RESULTS
MAN WEEKS
4 4 5 5 6 7 6 7 6 8 8 8 6 6 6 6
1 2 3 4 5 6 7 8
MONTHS ARO

FIGURE 2 PHASE A - PLAN CHART A

APPROACH

The approach for Phase A was based on the need to formalize basic data into categories for analysis. This data was then reduced, tabulated, plotted, and fully summarized in the report that describes the problems of coastal water quality monitoring. The approach used is outlined on Plan A Figure 2, with the tasks identified.

The following list of information was generated for the coastal areas of the United States for the national overview.

Coastal Zone Cross Reference List

State Water Quality Criteria Inventory

Data Bank Inventory

Environmental Inventory

Municipal Waste Discharge Inventory

Industrial Waste Discharge Inventory

Steam-Electric and Nuclear Power Plant Inventory

Ocean Dumping Inventory

Water Quality Monitoring Inventory

Laboratory and Facilities Inventory

Investigation of Factors Affecting Monitoring Activity

Synopsis of Approach to acquire Information Covering The Existing Water Quality Monitoring Activity

Laboratory Cost Evaluations

Legislative Inventory

Sampled Data Problems

APPROACH

The approach for Phase A was based on the need to formalize basic data into categories for analysis. This data was then reduced, tabulated, plotted, and fully summarized in the report that describes the problems of coastal water quality monitoring. The approach used is outlined on Plan A Figure 2, with the tasks identified.

The following list of information was generated for the coastal areas of the United States for the national overview.

Coastal Zone Cross Reference List

State Water Quality Criteria Inventory

Data Bank Inventory

Environmental Inventory

Municipal Waste Discharge Inventory

Industrial Waste Discharge Inventory

Steam-Electric and Nuclear Power Plant Inventory

Ocean Dumping Inventory

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Synopsis of Approach to acquire Information Covering The Existing Water Quality Monitoring Activity

Laboratory Cost Evaluations

Legislative Inventory

Sampled Data Problems

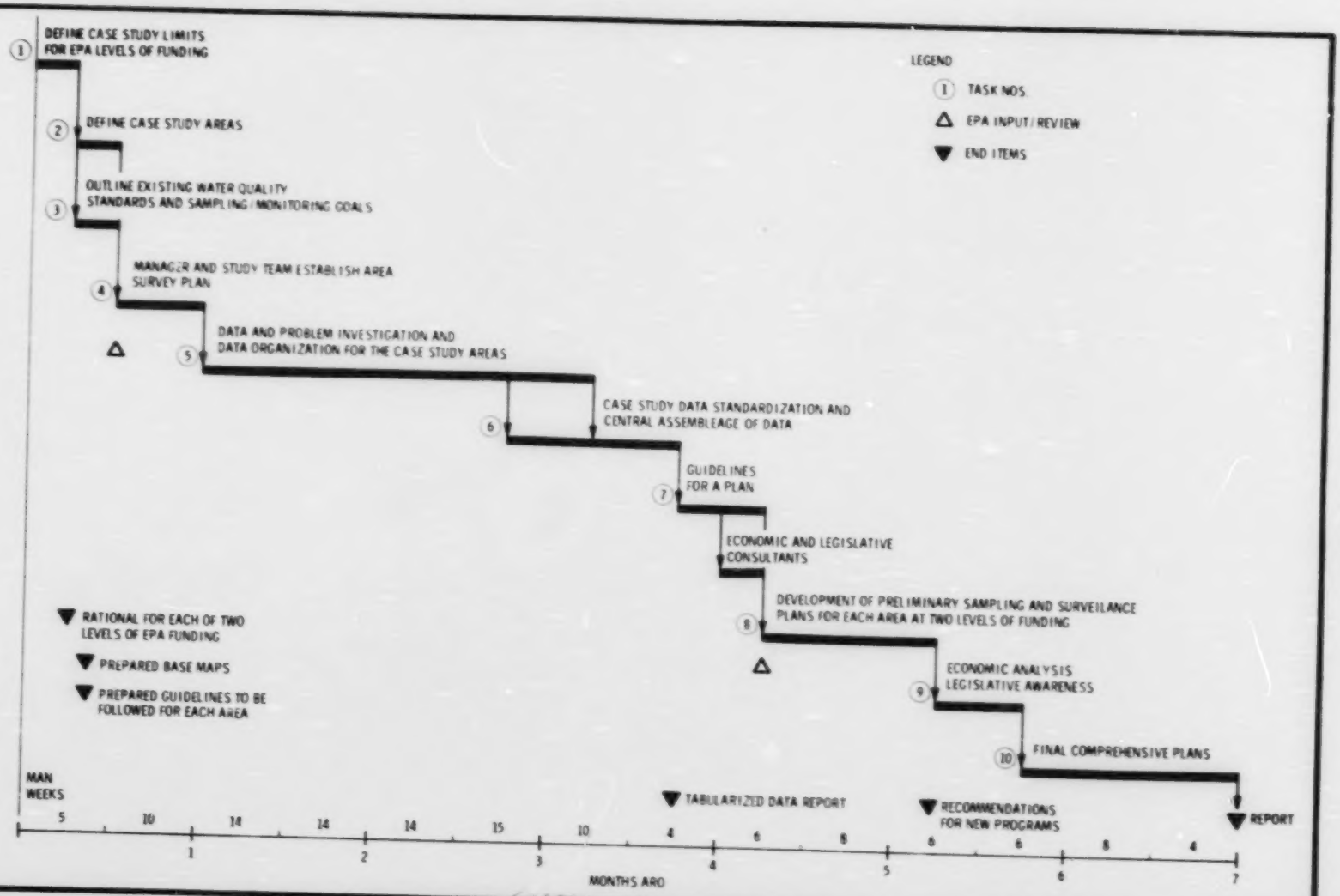
DEFINE CASE STUDY LIMITS FOR EPA LEVELS OF FUNDING
DEFINE CASE STUDY AREAS
OUTLINE EXISTING WATER QUALITY STANDARDS AND SAMPLING/MONITORING GOALS
MANAGER AND STUDY TEAM ESTABLISH AREA SURVEY PLAN
DATA AND PROBLEM INVESTIGATION AND DATA ORGANIZATION FOR THE CASE STUDY AREAS
CASE STUDY DATA STANDARDIZATION AND CENTRAL ASSEMBLEAGE OF DATA
GUIDELINES FOR A PLAN
ECONOMIC AND LEGISLATIVE CONSULTANTS
DEVELOPMENT OF PRELIMINARY SAMPLING AND SURVEILANCE PLANS FOR EACH AREA AT TWO LEVELS OF FUNDING
ECONOMIC ANALYSIS LEGISLATIVE AWARENESS
FINAL COMPREHENSIVE PLANS
LEGEND
TASK NOS.
EPA INPUT/REVIEW
END ITEMS
RATIONAL FOR EACH OF TWO LEVELS OF EPA FUNDING
PREPARED BASE MAPS
PREPARED GUIDELINES TO BE FOLLOWED FOR EACH AREA
TABULARIZED DATA REPORT
RECOMMENDATIONS FOR NEW PROGRAMS
REPORT
MAN WEEKS
5 10 14 14 14 15 10 4 6 8 8 6 8 4
1 2 3 4 5 6 7
MONTHS ARO

FIGURE 3 PHASE B - PLAN CHART B

APPROACH

In parallel with the above, information was acquired in Phase B for nine specific areas using a common set of guidelines: New York Bight; Charleston, SC; Biscayne Bay, FL; Pensacola, FL; San Francisco, CA; Oregon and Washington coastal area; Chicago, IL; Calcasieu, LA; and Los Angeles/Orange Counties, CA.

City, state, and government sources of data on local monitoring activities were interviewed by a field survey team to obtain information about the physical, chemical, and biological characteristics of the area, the existing pollution sources and problems and the requirements for a sampling and surveillance program. An inventory was prepared for existing facilities, capabilities and resources, sewage and thermal outfalls, offshore dumping grounds, laboratories, monitoring stations, and parameters measured by all agencies presently analyzing water quality. Available published material was obtained and card indexed.

The approach was to use the information obtained:

- to update data from conventional sources,
- to generate plans for a local initial coastal water quality monitoring network, and
- as a basis for recommendations for an optimized, nationwide system.

Plan Chart B Figure 3 is the task approach used.

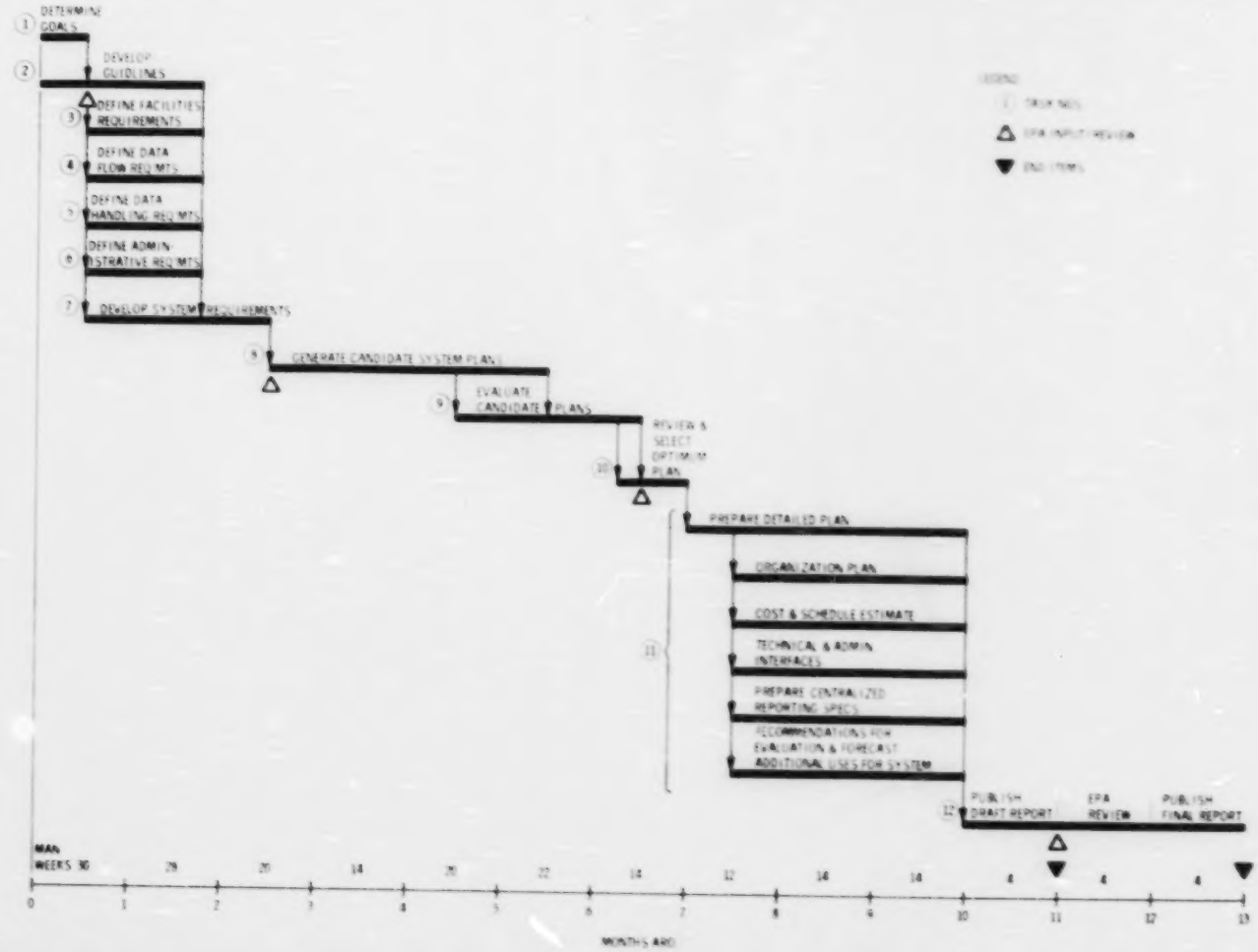
1 DETERMINE GOALS
2 DEVELOP GUIDELINES
3 DEFINE FACILITIES REQUIREMENTS
4 DEFINE DATA FLOW REQ MTS
5 DEFINE DATA HANDLING REQ MTS
6 DEFINE ADMIN ISTRATIVE REQ MTS
7 DEVELOP SYSTEM REQUIREMENTS
8 GENERATE CANDIDATE SYSTEM PLANS
9 EVALUATE CANDIDATE PLANS
10 REVIEW & SELECT OPTIMUM PLAN
11 PREPARE DETAILED PLAN
ORGANIZATION PLAN
COST & SCHEDULE ESTIMATE
TECHNICAL & ADMIN INTERFACES
PREPARE CENTRALIZED REPORTING SPECS
RECOMMENDATIONS FOR EVALUATION & FORECAST ADDITIONAL USES FOR SYSTEM
12 PUBLISH DRAFT REPORT
EPA REVIEW
PUBLISH FINAL REPORT
MAN WEEKS 30 28 20 14 20 22 14 12 14 14 4 4 4
0 1 2 3 4 5 6 7 8 9 10 11 12 13
MONTHS ARO

FIGURE 4 PHASE C - PLAN CHART C

APPROACH

For Phase C, a flexible iterative approach was used to foster a creative atmosphere where innovative concepts could be applied to the design. The key element was that of permitting preliminary design of several alternate, or "candidate," systems bounded only by generalized guidelines and requirements. These candidate concepts were then analyzed, reviewed, and condensed into an optimum system design which is fully documented in the form of a comprehensive plan for implementing a national coastal zone water quality monitoring network.

Phase C used the information gathered (in both Phase A and B) as primary elements to formulate the Initial Network Plan. The intent of the plan is to establish a methodology for the elements of data acquisition, data information flow, data storage, data retrieval, and data information usage. The Phase C Plan Chart, Figure 4, shows an interrelated task breakdown for the study effort.

PROGRAM SUMMARY

INTRODUCTION

The basic management process consists of five essential steps; plan, organize, staff, direct, and control. The Final Report deals primarily with the first area, planning. Planning encompasses the following main activities:

- document the status
- set objectives
- set goals
- establish priorities, sequences and timing
- set procedures, and
- standardize methods.

The Phase A study was structured to document the status and the resources currently available, to utilize results of this information, to set objectives and goals, and to establish a coordinated requirements plan for the utilization of resources and capabilities in a National Coastal Water Quality Monitoring Network. Phase A obtained an overview of the problems concerning coastal water quality monitoring. The overview included a consideration of the effects of the environment, population density, ocean dumping areas, and point source waste discharges on coastal zone water quality monitoring requirements.

SUMMARY

In parallel with the above, information was acquired by field survey in Phase B for specific geographic areas (case studies). The scope of present monitoring, projected monitoring requirements and establishment of data management requirements were investigated. The goal of this phase was to develop a coastal water quality monitoring plan for each of the nine geographically, environmentally, and politically different areas based on a similar set of ground rules with maximum use of existing capabilities and facilities. The commonality of thinking, and planning by people from the various areas and the identification of most of the common and unique factors in the areas made Phase B an important part of the total program.

Phase C used the information gathered in Phase A and B as primary elements for an Initial Network Plan. The intent of the Phase C plan was to establish a methodology for data acquisition, data and information flow, storage, retrieval, and information usage. The plan also allows for upgrading for new technology, changing requirements, and funding.

PHASE A SUMMARY

In order to develop a national plan, it was necessary to have a national overview of the coastal zone to determine the waste discharged into it and the water quality monitoring activities presently conducted.

Eighty-two million people live in the 325 counties of the 30 states that comprise the coastal zone, representing 41 percent of the country's population; an increase of 16 percent from 1960 to 1970. The coastal zone, including the Great Lakes but excluding Alaska, has 58,508 miles of tidal shoreline and 9,422 miles of general shoreline, with an average density of 8,700 people per mile of general shoreline.

Water Quality monitoring activities are managed from the national, regional and state levels. The division of EPA into regions is necessary for administrative and management convenience; however, coordination between regions is essential.

Relationship With Other Factors

In general, this study revealed no significant correlation between coastal zone water quality monitoring activity and population, population density, area, municipal or industrial waste discharge, or number of water quality laboratories. A slight correlation exists with total miles of general shoreline.

There is at least 9,400 MG of municipal waste, 15,000 MG of industrial waste and 73,000 MG of thermal-affected water discharged daily into the coastal zone. The total discharge into the coastal zone from both waste and thermal sources is about 100 billion gallons per day; this is equal to about 1,218 gallons per day per person, whereas municipal waste discharge amounts to about 114 gallons per day per person. Most of these figures are conservative as the inventories revealed plants for which there was no discharge data available.

The most intensive monitoring programs have developed due to rapidly rising levels of pollution such as in the Great Lakes. The large number of stations and total measurements per year is probably related to the fact that the waters of the Great Lakes are fresh and used by many municipalities as the source of drinking water.

An assessment of 104 data banks was made. Of this total, 19 currently provide water quality data input to the EPA Storage and Retrieval System (STORET). There are 38 additional data banks with water quality data not currently on the STORET system. There are 40 data banks with data other than water quality data that is relatable to trends in the coastal environment.

From the inventory it was found that the sample collection agencies are understaffed and underequipped to monitor in the manner they feel is necessary, but it appears that the number of laboratories, vessels and personnel are adequate to handle the analyses load for water quality monitoring, provided the sample load maintains the same approximate geographic distribution.

Present Monitoring Activity

Some 1,872 water quality monitoring stations and 2.7 million measurements per year are listed in the national computerized files; however, it is estimated that there are at least 6,800 active water quality monitoring stations in the coastal zone producing 3.5 million measurements per year. Thus, on the average, there are about 500 measurements taken per station per year in the nation's coastal zone, where a measurement is defined as one sample of one parameter. However, based on a small survey of existing water quality monitoring programs conducted for thermal, municipal and industrial waste dischargers, it can be projected that at least 11,000 stations and 4.25 million measurements per year are needed to meet the requirement for waste discharge monitoring. The coastal zone areas in between points of discharge would require additional monitoring.

PHASE B SUMMARY

After data on the national overview had been collected, the next step was to develop plans for several specific case study programs. The concept of this phase was to develop coastal water quality monitoring plans for each of the nine different areas based on a firm set of ground rules that would maximize the use of existing capabilities and facilities. Because of geographic differences, population densities, and industrial complexes the plans are not exactly the same, but due to a single goal, there is a great deal of commonality between them.

The impact of intense public interest in environmental activities of federal, state, and local governments has resulted in accelerated government actions. The effects have been seen in frequent reorganization of many agencies at all levels of government. As a consequence of this and normal publication time lags, much of the recent information is not readily available from public sources. In view of this situation, trained technical personnel were sent into the field to make personal contact with the cognizant people and agencies and to survey specific, representative coastal zone areas to obtain current in-depth information. Excellent cooperation was received from all of the groups and people interviewed.

PHASE B

Information was gathered on the extent of present monitoring, data processing, reporting, and storage. Total facility capabilities were determined as well as the parameters and monitoring goals local users desired to attain. Additional information was obtained, including the current method of data handling and processing, familiarity with the STORET system and other federal data processing systems.

Other factors studied were the socio-economic and political features of the area that had an impact on, or were impacted by, the quality of the coastal zone water. Where possible, up to date organization charts were obtained or prepared for state and local agencies. The agency organization data was compiled to present the existing system showing who collected what data, how it was used and where it was distributed. Included in the nine case study area reports are:

- descriptions of existing coastal zone water quality monitoring activities,
- a design specification for an initial network, and
- recommendations for a future optimum network.

From the information gained, a recommended Initial Network was designed to integrate the existing activities into an information system that would meet the needs of local and national levels.

Nine initial networks were designed. Each network can operate independently as well as be integrated into an Initial National Network.

The basic philosophy of the Initial Network design is one which encourages local users to use an existing automated system for storage and data transmission and storage from their facilities to their headquarters. This results in automatic entry of data into a computer system.

In some areas, notably Florida, New York, Louisiana, and California, there exists state-operated automated water quality data systems which are normally accessable to most local agencies. Access to state data systems by national or other external agencies can usually be arranged on either an inquiry basis or through data exchange procedures. In those areas lacking a state or local system, arrangements can be made to provide direct or indirect access to the EPA National Computing and Data Processing System for data entry, storage, and report generation. In either case, both national and local access is provided to data collected in the area of interest.

PHASE C SUMMARY

PL 92-500 and PL 92-532 created requirements for better and more timely reporting, established a requirement for coordinated action and placed heavy emphasis on the state's activities. There is a need to provide vital interfacing capabilities to allow local, state, regional and national activities to readily and economically utilize existing data. The commonality of thinking and planning by people from the various geographic areas and desirability of assessing commonality factors made Phase B important because it was those factors that formed the guiding criteria used in Phase C. The Phase C final report is a plan for a National Coastal Water Quality Monitoring Network, called EPA-NET, which is a water quality management information system developed around an Information Center concept.

EPA-NET

The EPA-NET design used the results of studies reported in Phase A and B as a foundation for the most effective national network projecting the development on a three-step basis. The first two steps involve the implementation of the Initial Local Networks and the Initial National Network, while the third step provides the Program Development Plan for the Future Integrated Network which allows for growth and evolution. The major distinction between these network efforts is in their scope; the first is largely based on use of "existing capabilities", while the latter

is broader in concept and more directed in its overall objectives.

Figure 5 shows three significant interface levels and seven functional activities which have been considered for the design of EPA-NET.

For example, the Network is designed with flexibility so that each of the seven subsystems can be developed independently, yet as the system is put together the interfaces and interrelationships between subsystems and the Information Centers becomes a two-way path wherein the entire system loop is closed.

Figure 6 provides an overview-perspective for the network development, from resources and equipments through the development stage, including typical documentation needed for present and future visibility and coordination.

With this background in mind, the EPA-NET's primary purpose is to provide proper user-oriented information at all levels. It will provide for communication of information, formatting of data, processing of data into information and results, with appropriate input/output availability.

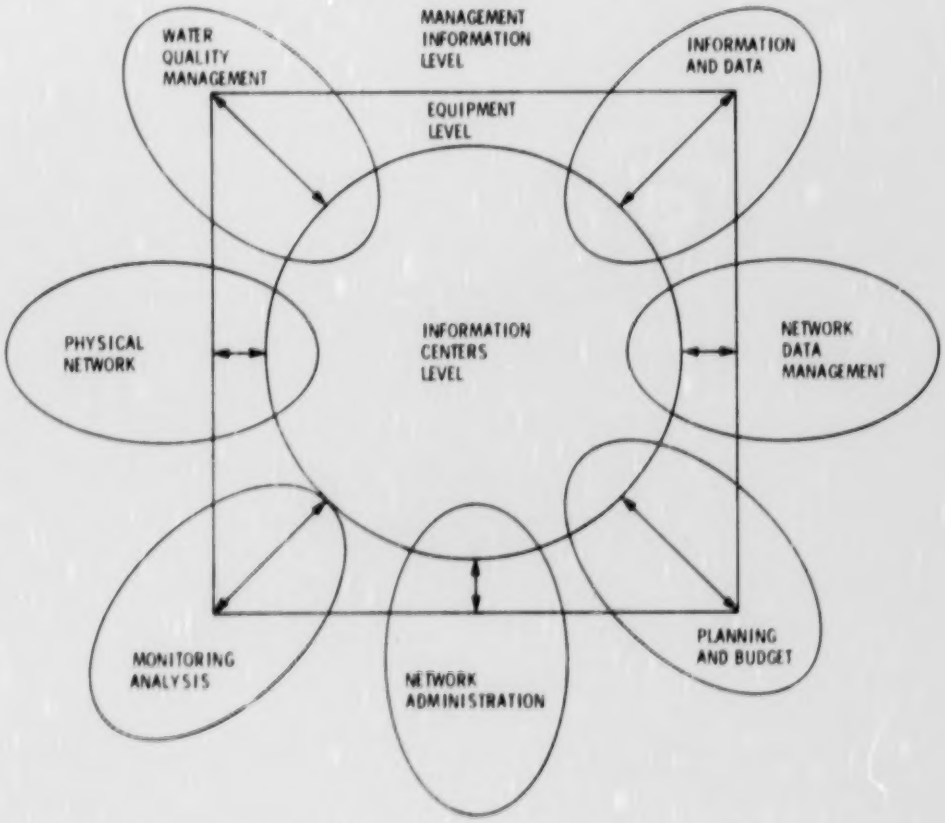

FIGURE 5 NETWORK SUBSYSTEMS AND INTERFACES

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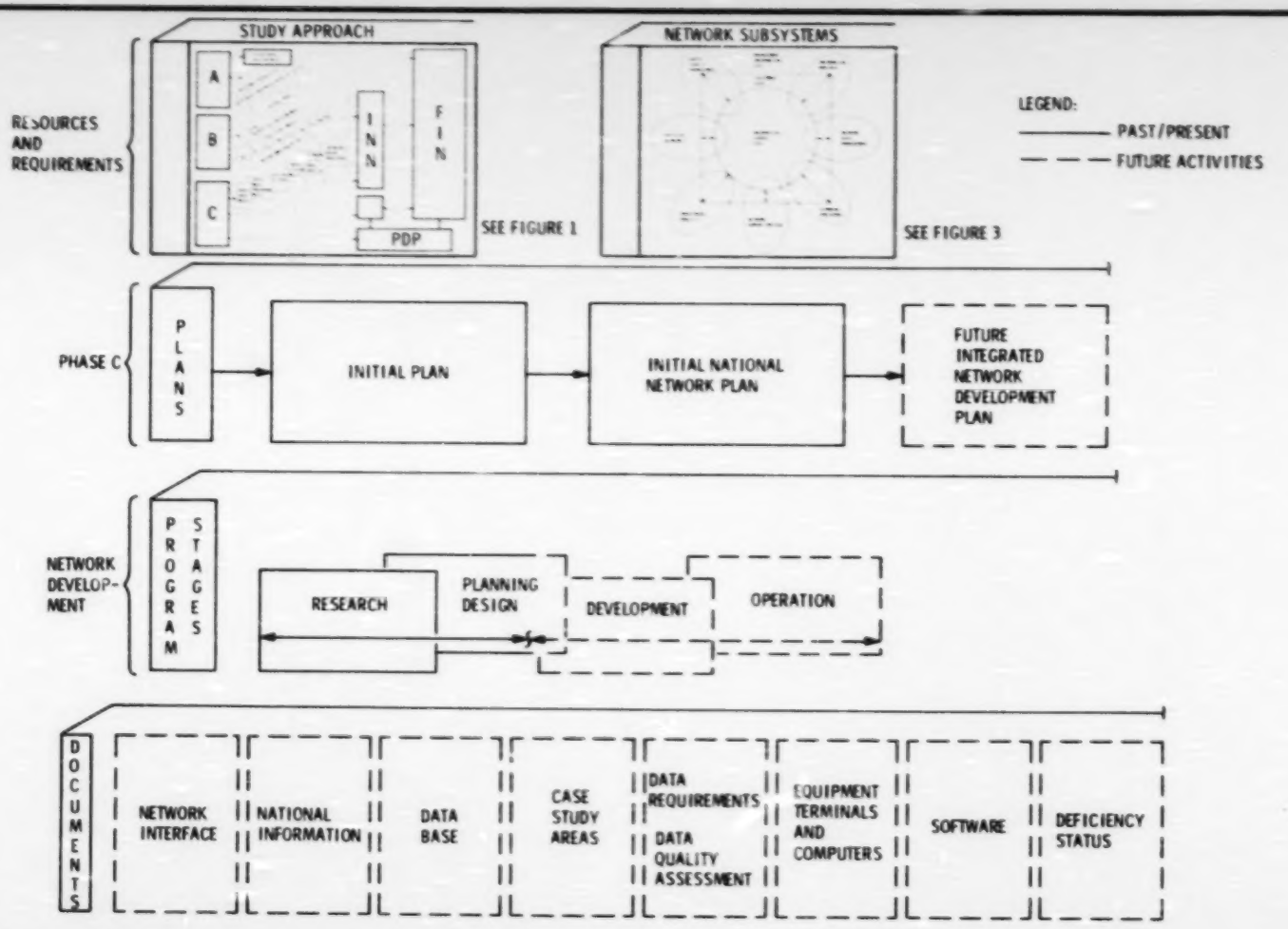

FIGURE 6 ELEMENTS OF THE NETWORK PLAN

INTERSTATE ELECTRONICS CORPORATION

PHASE C

The emphasis for the NETWORK has been "organization for coordinated activity," having determined that the necessary details of data processing and control are well within the state-of-the-art.

The key to a useful and dynamic EPA-NET is information exchange, not just data exchange, but information exchange. Useful information that can be readily applied in the decision making process. Information flow starts at the local level where the most detailed information is needed to solve the problem. There is a need for data in several forms, usually becoming more summarized at the state, regional, and national levels. Detailed data entered into EPA-NET at the local level, would be available to all network users.

Key to the EPA-NET is that the system automatically accommodates various information levels allowing for optimum data bases at each level, and allowing all users to obtain needed information. The system, in providing such a high degree of visibility to all levels, performs the role of a key management information system. It provides the basis on which rapid decisions can be made at both local and upper governmental levels by planning and budgeting sections.

Network Considerations

A plan providing for flexibility and growth is important, it would minimize the differences in requirements of local users and those at the national level. To meet this task effectively and present the data in the proper form to all users there are several priorities:

Data Formatting

Considerable amounts of data are not usable because of a lack of uniformity in scaling, scientific units, and reporting format. Thus, all monitoring data must be in a prescribed format as most agencies are concerned with basically the same parameters. The design of a format is, a primary item for the highest level of organization.

Data Display

Organization of an optimum system must be such that at EPA headquarters (and certain regional and local information centers,) all coastal zone water quality data is available and capable of being displayed on the appropriate media for use or review. Integrated access to data has been determined to be a major factor in administrative efficiency.

The display media and processing system must be capable of providing data ranging from digitally stored imagery through graphic plots of desired parameters.

While a central display approach is required to meet national requirements, many local user requirements can be met by less sophisticiated designs of local data centers. The common low-speed terminal unit with telephone coupler and cassette tape storage unit can meet a majority of local requirements.

Data Analysis

Data, presented in a standardized format, would provide local users with more usable information than is currently available to them and would also lead to a reduction of the duplications of efforts and personnel with some cost saving.

At the present time, most trend analyses are conducted using manual methods. The result is a time lag that prevents the necessary urgency required to initiate local action. Relocation of these efforts to the centralized processing and display facility would greatly improve the overall speed and planning capability. A centralized EPA-NET could then provide

evaluation services with recommendations on how to correct undesirable trends. By utilizing correspondence editing and compiling programs, finished reports could be prepared for local personnel using data from the data bank.

Evaluation of Control Procedures

In order to evaluate the impact of a new control procedure or method, comparisons must be made between the original data base and the data base obtained after implementation of the procedure or method.

A centralized system, with inputs from a variety of facilities and sources (some of which are not related to the organization initiating the control procedure or method), permits an agency to determine rapidly, without bias, whether the implementation is achieving its intended goals.

A centralized data system will provide results for comparison between areas with similar ecological structures. The success or failure of specific control procedures and methods can be reviewed. The before and after data base allows corrective measures to be employed in comparable areas to provide considerable

data for planning prior to implementation of a new procedure or method.

One of the Phase C Study goals was to determine the most cost effective interim system that could be obtained using capabilities now in existence. A study was made of forty-one governmental computer systems that could conceivably be utilized for this purpose. Of these, 12 are feasible systems.

As a result of this survey, it was concluded that an EPA National Computing and Data Processing System would be the most effective, and would require only appropriate programming and peripherals to allow other data bases to be effectively used. Therefore, the initial network approach was to determine the most convenient and economical means of getting local agencies and organizations to introduce their data directly into such a system.

The Information Center concept is structured for modular growth, which allows the network to be developed around a strong National Information Center by the Case Study Area approach. Figure 7, a diagram of the basic Information Center structure, indicates some of the functional activities at each level as well as the common communicability between all levels. Initially, EPA-NET will use the centralized communication and processing capability of the

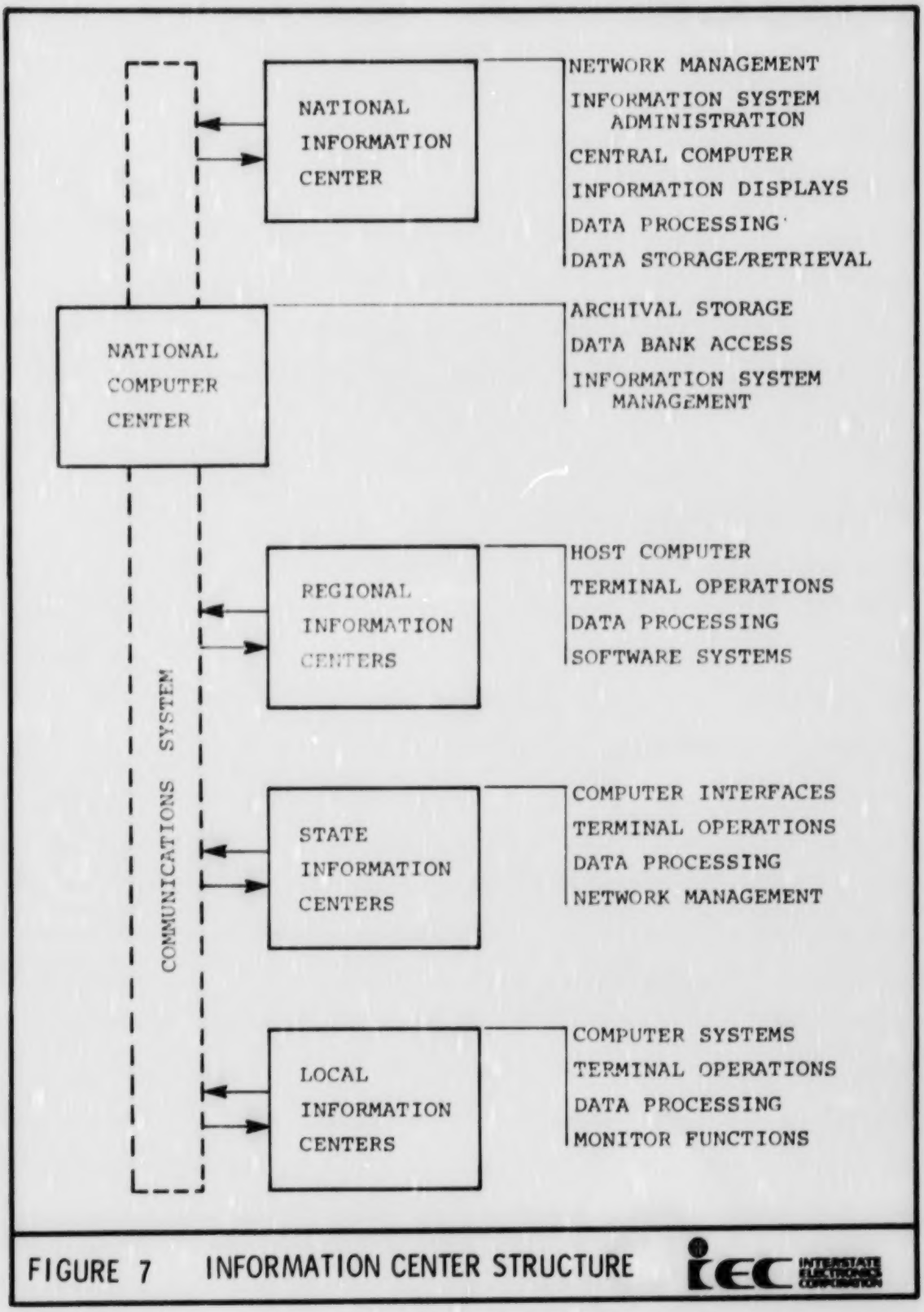

FIGURE 7 INFORMATION CENTER STRUCTURE

STORET system as the National Computer Center, but in time, the National Computer Center will accommodate STORET and other data files to meet its full requirements. Although the Information Centers are functionally operated at each level, the network development and management must be handled from the national level. The management and administrative activities are streamlined to maximize operations with a minimum of effort and expense.

Initial National Network

The organization of the existing data monitoring capabilities is the Initial National Network. This is based on achieving a significant improvement in the current processing of data merely by reorganizing the present work within the case study area on an integrated rather than fragmented basis.

In configuring the Initial National Network, it was apparent that the future requirements had to be considered, while making use of existing capabilities. A goal of the plan was to include state-of-the-art technologies and their future projection. From trend indications in legislation, it was concluded the future objectives will be considerably more stringent than those at present. It was recognized that growth and evolution of technology and methods will occur. Thus a flexible information exchange method, wherein each level of government can communicate

vertically and horizontally within and between agencies, was designed as the best approach.

In the overall design of EPA-NET the Initial Network will provide: guidelines for the utilization of existing capabilities; the organization of monitoring activities at the local level; permit development of criteria for acquisition of monitor data; recommendations for present and planned data system services; for the administrative and management functions of the operating network.

It is also concerned with specification of communication terminal locations, organization of monitoring agency activities, development of data base requirements, and maximum use of present monitoring system capabilities. Other tasks will address the general subjects of monitoring methods, utilization of monitor data, and information flow required for performing pollution control actions.

Recommended data management and administration assistance activity will be developed for the local areas as well as for the state, regional, and national levels. In all cases, the program will utilize existing capabilities in the implementation of the monitoring network.

The Initial Plan is the first part of a systematic approach directed towards meeting the present and future water quality information needs. A prime objective of the Initial Plan is to establish procedures which will allow the required water quality data to be obtained for user purposes at a favorable cost.

In the approach to network system design, a pilot implementation with existing capabilities is required. The New York Bight Initial Network Plan developed in the B-1 report is considered the first step in the implementation of the Initial National Network.

The Situation

As an example to demonstrate what can be expected, an actual situation based upon a detailed Phase B Case Study Area of the New York Bight (Report 445-B1) is used to show the existing capabilities. Figure 8 is representative of activities up to January 1, 1972 and shows that the only group inputting data into the STORET system (or any other cooperative system) was the EPA Region II. Each of the major monitors shown in Figure 8 have and maintain data files of one form or another, five of the seven use computer storage and/or analysis technologies in some form, while two indicate reports and data files as their end resource. Information exchange was only by request and manual submissions of reports and/or data, even though data forms may be prepared

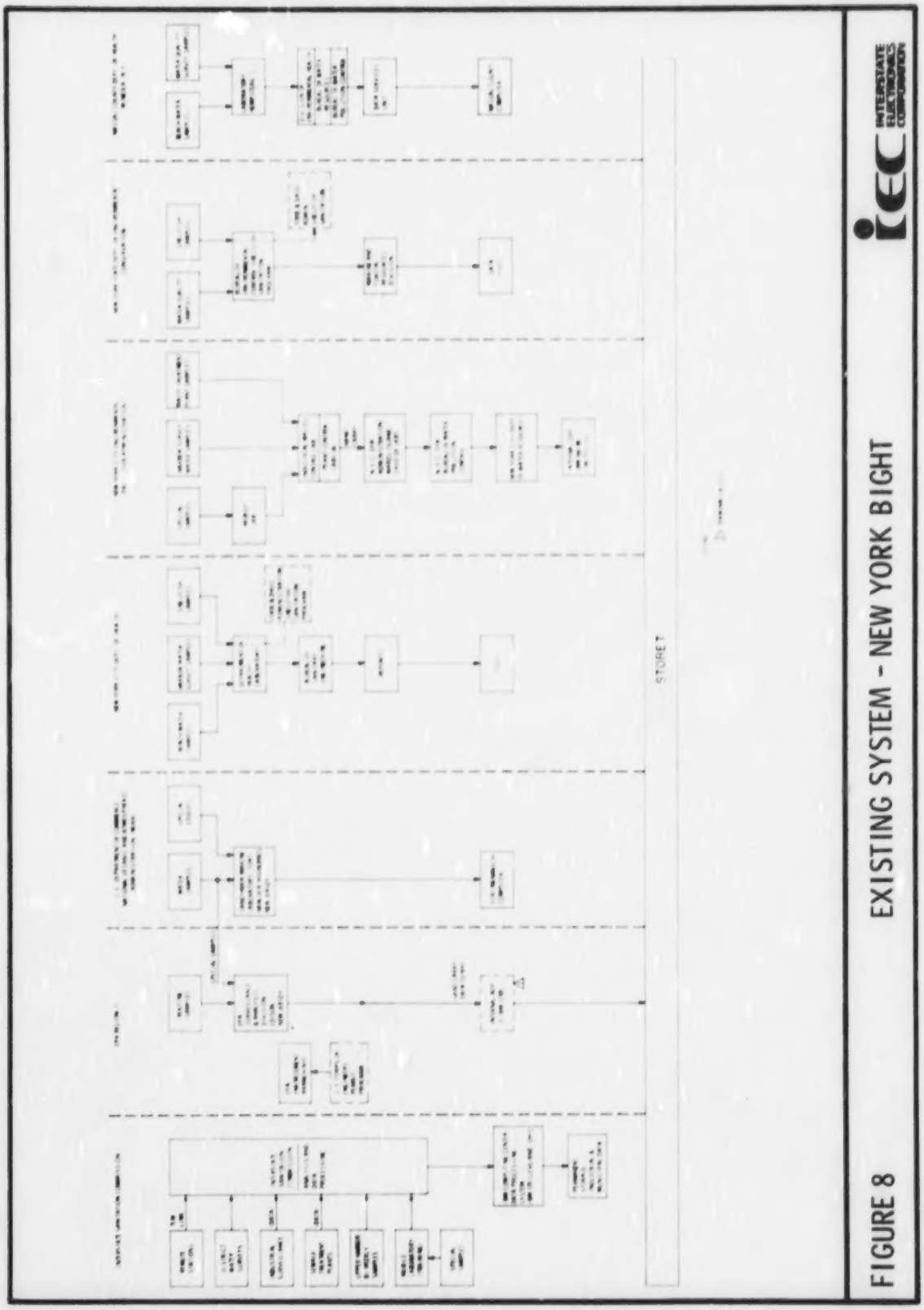

FIGURE 8 EXISTING SYSTEM - NEW YORK BIGHT

automatically. The situation was basically the same for the other case study areas. Certainly there is no uniformity, and consequently, no simple solution to the problem of achieving a coordinated monitoring system and comprehensive information exchange.

The Proposed Initial Network

To improve communication by utilizing existing capabilities, Initial Networks for the nine case study areas were designed. Figure 9 is an example of such a proposed network. It shows the EPA National Computing and Data Processing System, the primary coordinated communications and processing system of the EPA-NET. The recommended Initial Network brings all seven of the major agencies to a common focal point, thereby allowing the various data to be readily available to all, and for federal, state and city management's improved visibility for planning, budgeting, and legislative purposes.

The Initial Network shows that the first step to achieve a coordinated activity is to provide each agency with proper training to achieve access to EPA National Computing and Data Processing System, thereby allowing each agency data input and inter-agency data exchange. The use of computer terminals improves communications between and within agencies, and provides

PHASE C

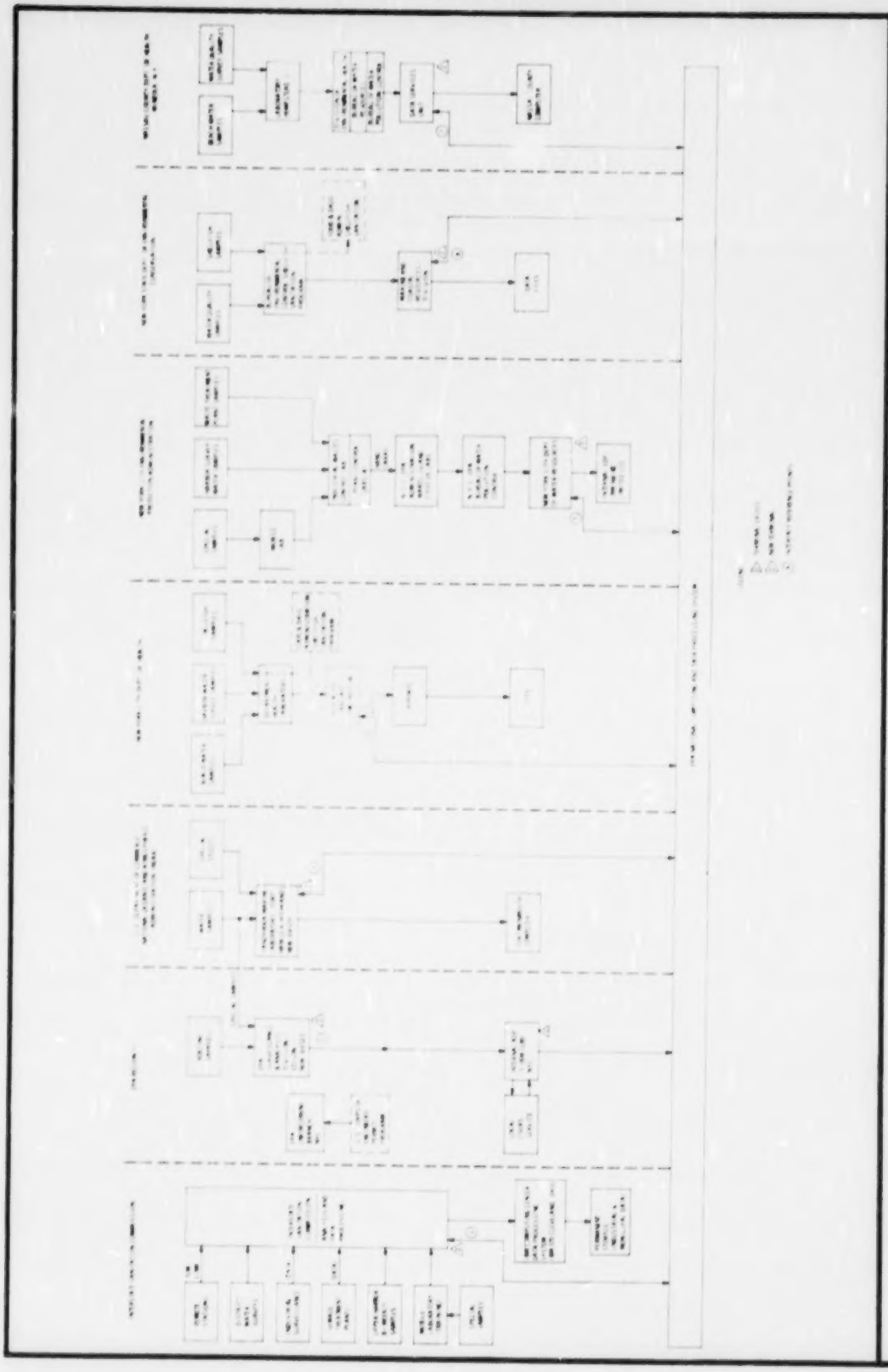

FIGURE 9 INITIAL NETWORK - NEW YORK BIGHT

INTERSTATE ELECTRONICS CORPORATION

computer power for various processing, analysis and report formatting programs. Implementation of the Initial Network in the New York Bight and at subsequent case study areas will provide assistance, coordination, and indoctrination of local users in the philosophy of the EPA National Computing and Data Processing System.

Additional areas should be added according to the plan to ultimately include all the case study areas. The purpose of such a program is to form the network progressively, case study area by case study area, allowing each subsequent area to provide added insight for the remaining ones and tailoring the network to the user need at all levels (local, state, regional, and national).

In the Initial National Network, the data is to be obtained and processed by the same local agencies currently performing these functions. The major changes proposed are in the methods of handling and the transmission of the data after the laboratory analyses have been performed. There are certain program modifications that will permit more effective use of the incoming data by the various case study area personnel, and by EPA, as a national management tool. Because of its availability, the existing STORET system is shown as the candidate EPA National Computing and Data Processing System.

PHASE C

In all cases, the implementation of the Information Center approach provides for more local access to nationwide information, which will increase operational and research visibility for all geographical areas. Direct entry of data into the system, can significantly improve the response time for information availability. The use of the low-speed terminal and telephone coupler is practical and can provide direct access to national computer systems from any point within the United States.

Implementation can easily be accomplished by the use of additional low-speed terminals at strategic points. In addition to rather simple hardware requirements, it is recognized that some new programming and modification of existing programs will be required to more accurately meet the needs of the data users at the local level. The system could provide greatly increased program capability and, at the same time, drastically reduce the workload of the state and local agencies currently involved in monitoring.

Future Integrated Network

The Initial National Network for water quality monitoring can be developed utilizing the most recent technological developments in both software and hardware and integrating it into the optimized national system, the Future Integrated Network. The use of real

time telemetry techniques coupled with advances in remote sensors would result in a system that will meet most requirements, at considerable cost savings to local agencies, and at the same time will permit EPA to monitor any area in the coastal zone, on a real time basis, from a central location.

There are two primary perspectives; the national perspective, and the local perspective. Both are important to the establishment and maintenance of the EPA-NET, and either may be highlighted based upon availability of funds or the initial emphasis desired.

Ideally, the network should be developed for both perspectives, allowing improved data to be coordinated into the network, as well as developing the necessary management and administrative capabilities of a total network. The National Information Center should be implemented early to provide a maximum of information exchange at the national levels. This would maximize the use of the existing data base information available through STORET by national personnel. On the other hand, Local Information Centers should be implemented early to provide the best access for local monitoring data, which will optimize information exchange for management solutions of local problems.

Depending upon program priorities, the emphasis can be shifted to maximize particular requirements, yet the design concept, because

it is modular, allows future broader perspectives to be included as priority funds permit.

Initially, the Network will use the centralized communication and processing capability of the EPA STORET system as the National Computer Center; which will be augmented by the establishment of Information Centers to provide a capability for each Information Center to maintain its own data bases.

A distributed capability will be accomplished with the planned addition of sub-nets by permitting utilization of existing systems throughout the network development because the capability for data acquisition, data analysis, and decision-control actions will be focused at Regional and/or State Information Centers. By utilizing the Information Centers as part of the system, the development can proceed effectively from the Initial National Network to the Future Integrated Network.

EPA-NET Program Development Plan

The EPA-NET's primary purpose is to provide user-oriented information to all required levels. It will provide for the communication of information, format of data, processing of data into needed information, input/output availability in a concise form, and minimize the need for high operator skills.

PHASE C

The EPA/NET design used the results of studies reported in Phase A and B as a foundation projecting the development on a three-step basis. The first two steps involve the implementation of the Initial Local Networks and the Initial National Network. The third step is a Program Development Plan for the Future Integrated Network, which provides for growth and evolution. This time-ordered schedule of 17 tasks is to be conducted during a 4 year period. The major distinction between these network efforts is in their scope. The first two are largely based on the use of existing capabilities, while the latter is not as limited in concept.

A four year schedule has been projected (Figure 10) wherein the Initial National Network is developed using the Case Study Area process to establish input into the system, and exchange at all levels. The nine case study areas (studied to date) could be implemented by the end of the first year and integrated into the network by the end of the second year. The second and ensuing years would allow growth of the network by utilizing existing capabilities, and evolution to achieve the Future Integrated Network which would meet the requirements for national coastal water quality monitoring.

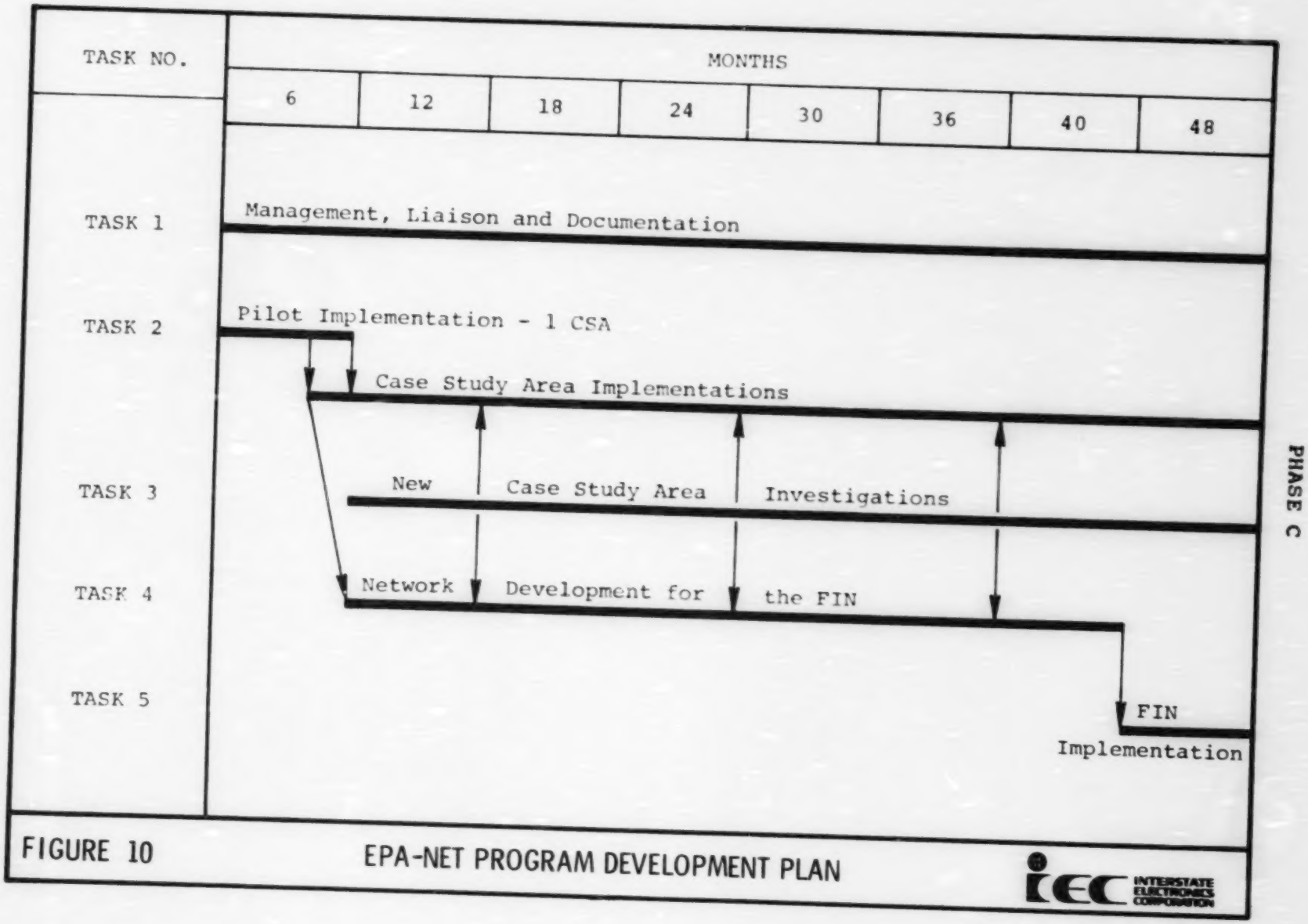

FIGURE 10 EPA-NET PROGRAM DEVELOPMENT PLAN

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PHASE C

CONCLUSIONS

Conclusions, Phase A

1. There does not appear to be any significant relationship between coastal zone water quality monitoring activity and population, population density, area, municipal or industrial waste discharge, or the number of water quality laboratories.

2. The present study shows that ongoing monitoring at current ocean disposal sites for assessing environmental effects is insufficient, and in some areas practically non-existent.

3. Present monitoring programs are not adequately supplying the information necessary to protect the future quality of the coastal waters. Programs and parameters established in the past are not providing enough environmental information to detect and evaluate the impact of man's activities on the aquatic environment.

CONCLUSIONS

4. Primary efforts in monitoring should be concentrated on those parameters which provide information on heavily polluted areas and pollution sources.

5. There is a significant portion of the national coastline that is remote and inaccessible, presently unaffected by pollution by continuous discharges. These areas need a few carefully planned monitoring programs, but do not require widespread programs for source monitoring.

6. Well-equipped analytical laboratories are available for analysis of samples obtained from existing long-term monitoring programs. Adequate laboratory support may not exist in some areas, but with rapid air freight and modern shipping techniques, samples can be sent to laboratories. Accuracy problems may result if long traveling distances are involved for the samples or the receiving laboratory has pre-set priorities not permitting timely sample processing.

CONCLUSIONS

Conclusions, Phase B

1. There is a lack of data priorities at all levels. There is no agreement as to the need for data, sampling rates, and accuracies for most parameters. Many parameters are measured excessively just because they are easy to measure.

2. There is a lack of standardized reporting and data processing. National and state formats are not standardized. Sometimes several different formats are found within a single agency.

3. Existing data systems are poorly organized and lack adequate programming.

4. There is duplication of effort and lack of inter-agency coordination. In one area over 20 agencies are monitoring water quality, yet no one agency is performing a comprehensive program.

5. The funding is fragmented which results in the lack of adequate funding to any one agency and an overall excessive expenditure.

CONCLUSIONS

Conclusions, Phase C

1. Significant economic advantages and technical improvements can be obtained by achieving "cooperation" between the various agencies. The EPA-NET recommended is designed for obtaining these advantages by use of an Information Center concept, a means to achieve user information at all levels of need.

2. A Program Development Plan delineates how the EPA-NET can be systematically and economically developed on a timely basis through three approaches:
   - Implementation of the Initial (Case Study) Network Plans.
   - Implementation of the Initial National Network Plan utilizing existing capabilities.
   - Development and implementation of the Future Integrated Network.

3. Development of the EPA-NET is contingent upon cooperative support by all agencies of government making maximum use of existing facilities and personnel.

RECOMMENDATIONS

Recommendations, Phase A

1. There exists a large amount of information outside of the national computerized files. Significant material should be screened, formatted and compiled. Data which is not considered as a "sample" may be combined with other data to actually become monitoring data.

2. All new programs involving water quality data with federal government support should require that the contractor enter the data at regular intervals into a national system.

3. Existing dischargers self-monitoring programs should be expanded into all states to cover all dischargers. Both the discharge and the receiving waters should be monitored. Improvements or changes are necessary in the parameters monitored, methods of sampling, training of monitoring personnel and laboratory techniques.

RECOMMENDATIONS

Recommendations, Phase B

1. The field case study program should be expanded to cover the remaining known problem areas of the coastal zone.

2. EPA should establish and chair a special ad-hoc organization to facilitate planning, data exchange, and cooperation between the various federal, state and local organizations involved in coastal zone water quality monitoring.

3. EPA should establish a national credential system and associated training program to provide certification for laboratories involved in water quality monitoring. This program would emphasize the aspects of estuarine and coastal water analysis that are now a problem to laboratories that normally handle only freshwater analysis. Such a system would be the first step in a comprehensive data quality assurance program.

4. EPA should establish a program in cooperation with the National Oceanographic Instrumentation Center, to standardize sensors and instrumentation systems and encourage the development of new sensors and systems for use in coastal zone water quality monitoring.

Recommendations, Phase C

1. Begin the plan with a pilot implementation program for the New York Bight case study area.

2. Continue the planning effort by developing the details and mechanism for the coordination of federal activities in the Washington D.C. area.

3. Following the implementation of the New York Bight pilot implementation program, continue the development of the Initial National Network by implementing the other eight case study area plans.

4. While the Initial National Network implementation is underway, proceed with the initial fact finding and planning at new case study areas.

5. Follow the Program Development Plan to develop the Future Integrated Network.

The Reports prepared under EPA contract 68-01-0160 by Interstate Electronics Corporation, Environmental Engineering Division are:

Report No. 445A	A National Overview of Existing Coastal Water Quality Monitoring
Report No. 445-B	Coastal Zone Water Quality Monitoring A Summary of Case Study Findings
Report No. 445-B1	Coastal Zone Water Quality Monitoring In the New York Bight
Report No. 445-B2	Coastal Zone Water Quality Monitoring In the Charleston Harbor, SC Area
Report No. 445-B3	Coastal Zone Water Quality Monitoring in the Biscayne Bay Area
Report No. 445-B4	Coastal Zone Water Quality Monitoring In the Pensacola Area
Report No. 445-B5	Coastal Zone Water Quality Monitoring In the San Francisco Bay Area
Report No. 445-B6	Coastal Zone Water Quality Monitoring In Oregon and Washington Coastal Area
Report No. 445-B7	Coastal Zone Water Quality Monitoring In the Chicago Area
Report No. 445-B8	Coastal Zone Water Quality Monitoring In the Calcasieu, Louisiana Area
Report No. 445-B9	Coastal Zone Water Quality Monitoring in the Los Angeles/Orange Counties Area
Report No. 445C	A Plan for a National Coastal Water Quality Monitoring Network
Report No. 445ES	A Plan for a National Coastal Water Quality Monitoring Network, Executive Summary